

Exhibit 10 to the Request for Inter Partes Re-examination of

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Applicant: Brad A. Armstrong

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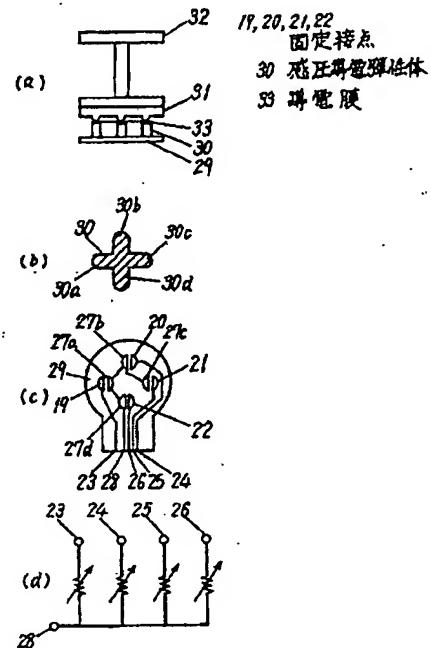
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(54) 【発明の名称】 感圧スイッチ

(57) 【要約】

【目的】 音響機器、映像機器、ゲーム機等の入力操作部に用いられる感圧スイッチにおいて、感度の良い押圧力検出を目的とする。

【構成】 4方向に配置した4個の独立した固定接点19～22に対向する共通固定接点27a, 27b, 27c, 27dを下部フィルム29に設け、固定接点19～22との接触側に対向した押圧操作面側に、導電膜33を形成した感圧導電弹性体30を固定接点19～22の上部に配置し、さらに、感圧導電弹性体30を押圧するための凸部が設けられた押圧板31と、力の加えられた方向に押圧板31を押す操作レバー32を押圧板31の上に配置して構成することにより、操作レバーの動きに対して、感圧導電弹性体30の抵抗値変化を感度良くすることができる優れた感圧スイッチが得られる。



【特許請求の範囲】

【請求項1】少なくとも2つの固定接点と、これら固定接点上に載置され、固定接点との接触側に対向した押圧操作面側に導電材料を塗布し導電膜を形成した感圧導電弹性体とからなる感圧スイッチ。

【請求項2】中央上部の押し鉗部と中央下部の押圧部と外周支持部とを有するドーム状弹性体を、感圧導電弹性体の上部に載置した請求項1記載の感圧スイッチ。

【請求項3】2つの固定接点上に、感圧導電弹性体を介して、ドーム状弹性体の押圧部を配置した請求項2記載の感圧スイッチ。

【請求項4】中央の固定接点上に、感圧導電弹性体を介してドーム状弹性体の押圧部を配置し、外周の固定接点上に、感圧導電弹性体を介してドーム状弹性体の外周支持部を配置し、前記ドーム状弹性体の押し鉗部が突出する孔を有するカバーにより、前記ドーム状弹性体の前記外周支持部を介して感圧導電弹性体を挟み込んだ請求項2記載の感圧スイッチ。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、固定接点上に、固定接点との接触側に対向した押圧操作面側に導電材料を塗布し導電膜を形成した感圧導電弹性体を配置した感圧スイッチに関するものである。

【0002】

【従来の技術】近年、音響機器、映像機器、ゲーム機等の入力操作部に用いられる感圧スイッチは、ポインティングデバイスの感度を向上させるよう要望が高まっている。

【0003】以下に従来の感圧スイッチについて説明する。図6(a)～(e)は従来の感圧スイッチの構成を示すものである。同図において1～4は4方向に配置した4個の独立した固定接点であり、5～8は固定接点からの引き出し線であり、9a, 9b, 9c, 9dは4個の独立した固定接点1～4にそれぞれ対向する共通固定接点であり、10はその共通固定接点からの引き出し線であり、これらは下部フィルム11に設けられている。12は上部フィルムであり、可動接点14が設けられている。13は固定接点と可動接点間の厚み方向の圧力によって抵抗値が変化する感圧導電ゴムであり、15は4方向に配置された感圧導電ゴム13の位置を押すための凸部が4方向に設けられた押圧板であり、16は押圧板の上に配置され、力の加えられた方向に押圧板15を押す操作レバーである。

【0004】また等価回路に示すように10の引き出し線と5～8の引き出し線との間の抵抗を測定する事によって個々の接点間の抵抗値変化を測定できる。つまり感圧ゴムの各部の上下間の抵抗値を測定する事によって、どの方向にどのような力で力が加えられたかという「方向」と「力の大きさ」を知る事ができる。

【0005】

【発明が解決しようとする課題】しかしながら上記の従来の構成では、感圧導電ゴム13の上に可動接点14を設けた上部フィルム12を配置する必要があるため、スイッチを操作する際、押圧板15の凸部が上部フィルム12を介して感圧導電ゴム13を押すことになり、上部フィルム12の厚みと剛性の影響により感圧導電ゴム13の感度が鈍くなるという問題点を有していた。

【0006】本発明は上記従来の問題点を解決するもので、圧力検出感度が優れた感圧スイッチを提供することを目的とする。

【0007】

【課題を解決するための手段】この目的を達成するためには本発明の感圧スイッチは、1つ、または少なくとも2つの固定接点と、これら固定接点上に載置され、前記固定接点との接触側に対向した押圧操作面側に導電材料を塗布した感圧導電弹性体を配設した構成を有している。

【0008】

【作用】この構成によって、4方向に配置した4対の独立した固定接点と、これらの固定接点からの引き出し線を配線したフィルムと、前記固定接点との接触側に対向した押圧操作面側に導電材料を塗布した感圧導電弹性体を前記固定接点の上部に配置し、これら固定接点の上部に配置された前記感圧導電弹性体を押圧するための凸部が4方向に設けられた押圧板と、前記押圧板の上に配置され力の加えられた方向に前記押圧板を押す操作レバーとで構成することによって、前記操作レバーに加えられた力が前記押圧板の前記凸部を通じて4方向の前記感圧導電弹性体に加えられる事により、前記感圧導電弹性体の抵抗値変化を引き出し線から読み取ることができる。

【0009】

【実施例】

(実施例1)以下本発明の第1の実施例について、図面を参照しながら説明する。

【0010】図1(a)～(d)において、19～22は4方向に配置した4個の独立した固定接点であり、23～26は固定接点19～22からの引き出し線であり、27a, 27b, 27c, 27dは4個の独立した固定接点19～22にそれぞれ対向する共通固定接点であり、28はその共通固定接点からの引き出し線であり、これらは下部フィルム29に設けられている。また、固定接点19～22との接触側に対向した押圧操作面側に導電材料を塗布し導電膜33を形成した感圧導電ゴムからなる感圧導電弹性体30の先端部30a, 30b, 30c, 30dを4対の独立した固定接点19～22の上部に配置している。

【0011】さらに、4対の独立した固定接点19～22の上部に配置された感圧導電弹性体30を押圧するための凸部が4方向に設けられた押圧板31と、押圧板31の上に配置され力の加えられた方向に押圧板31を押

す操作レバー32とで構成されている。また等価回路に示すように引き出し線28と引き出し線23～26との間の抵抗を測定する事によって個々の接点間の抵抗値変化を測定できる。

【0012】以上のように構成された感圧スイッチについて、図2を用いてその動作を説明する。

【0013】操作レバー32を矢印A方向の力で押すと、押圧板の4箇所の凸部には、押した位置に対応する矢印B方向の力が働く。特に感圧導電弹性体30にはB₁、B₂のように下向きに力が加わるので、感圧導電弹性体の先端部の30a、30b、30c、30dの上下間の抵抗値を測定する事によって、どの方向にどのような力で力が加えられたかという「方向」と「力の大きさ」を知る事ができる。つまり図5の等価回路出力特性図に示すような特性に従って抵抗値が減少する。例えば、感圧導電弹性体30の厚み方向の抵抗値が6KΩのときは押し圧は200gであるというように感圧導電弹性体30の抵抗値を測定する事によって押し圧力を知る事ができる。

【0014】以上のように本実施例によれば、感圧導電弹性体30の上面に薄い導電膜33が印刷等で形成されており、従来の上部フィルムが不要なことから、直接感圧導電弹性体30を押すことになり、ポインティングデバイスの感度を向上することができる。

【0015】(実施例2)以下本発明の第2の実施例について図面を参照しながら説明する。

【0016】図3において、41a、42aは対向する一対の固定接点であり、これらは出力端子41b、42bとそれぞれ導通しておりスイッチケース43にインサート成形されている。固定接点41a、42aの上部には、固定接点41a、42aとの接触側に対向した押圧操作面側に導電材料を塗布し導電膜44aを形成した感圧導電弹性体44が配置され、その上部には押し鉗部45aと押圧部45bと外周支持部45cとを有するドーム状弾性体45が配置され、カバー46で保持されると共に覆われている。

【0017】以上のように構成された感圧スイッチについて、図3を用いてその動作を説明する。

【0018】ドーム状弾性体45の押し鉗部45aが下向きに押圧されることにより、押圧部45bは感圧導電弹性体44の中心付近に接触し、さらに押圧されることにより感圧導電弹性体44は、固定接点41a、42aと押し鉗部45aに挟まれる形となり、厚み方向に加圧されることになる。この結果、感圧導電弹性体44の厚み方向の抵抗値は図6の等価回路出力特性図に示すように圧力と共に徐々に低下し、ついには出力端子41bと42b間は導通状態となる。すなわち電流が流れる経路としては、51b～51a～54～54a～54～52a～52bとなる。

【0019】以上のように本実施例によれば、従来のプ

ッシュスイッチにおいて感圧導電弹性体44の替わりに金属接点が配置されており、ON/OFFの状態検出しかできなかつたのに対して、押し鉗部45aを押す圧力に応じて出力抵抗値が変化するため、電圧比較器またはA/Dコンバータに接続することにより、多段階スイッチとして使用することができる。

【0020】(実施例3)以下本発明の第3の実施例について図面を参照しながら説明する。

【0021】図4において、51a、52aは一対の固定接点であり、これらは出力端子51b、52bとそれぞれ導通しておりスイッチケース53にインサート成形されている。固定接点51a、52aの上部には、固定接点51a、52aとの接触側に対向した押圧操作面側に導電材料を塗布し導電膜54aを形成した感圧導電弹性体54が配置され、その上部には押し鉗部55aと押圧部55bと外周支持部55cとを有するドーム状弾性体55が配置され、カバー56で挟み込まれている。このため外周支持部55cは、厚み方向に大きな荷重を受けており、厚み方向の抵抗値は小さく導通状態となっている。

【0022】以上のように構成された感圧スイッチについて、図4を用いてその動作を説明する。ドーム状弾性体55の押し鉗部55aが下向きに押圧されることにより、押圧部55bは感圧導電弹性体54の中心付近に接触し、さらに押圧されることにより感圧導電弹性体54は、固定接点51aと押圧部55bに挟まれる形となり、厚み方向に加圧されることになる。この結果、感圧導電弹性体54の厚み方向の抵抗値は図6の等価回路出力特性図に示すように加圧と共に徐々に低下し、ついには出力端子51bと52b間は導通状態となる。すなわち電流が流れる経路としては、51b～51a～54～54a～54～52a～52bとなる。

【0023】以上のように本実施例によれば、固定接点52a上部の感圧導電弹性体54がドーム状弾性体55の外周支持部55cを介してカバー56に挟み込まれているため、この部分での感圧導電弹性体54の抵抗値は充分低下しており、固定接点51a上部1箇所だけでの感圧導電弹性体54の抵抗値変化だけが、出力端子51bと52b間から出力されることになり、より安定した押圧力の検出が可能となり、電圧比較器またはA/Dコンバータに接続することにより、多段階スイッチとして使用することができる。

【0024】なお、感圧導電弹性体として、ゴム、樹脂、絶縁フィルムの上に感圧導電材料を塗布し導電膜を形成したものが用いられる。

【0025】

【発明の効果】以上のように本発明は、固定接点との接触側に対向した押圧操作面側に導電材料を塗布し導電膜を形成した感圧導電弹性体を用いたので、押圧部により直接前記感圧導電弹性体を加圧することとなり、従来の

上部フィルムを用いた構成に比べてより感度の良い圧力検出が可能である。

【0026】また可動接点に、導電材料を塗布し導電膜を形成した前記感圧導電弹性体を用いてブッシュスイッチを構成することにより、従来の構成では不可能であった多段階スイッチとして使用することも可能となった。さらに従来のブッシュスイッチの可動接点の替わりに前記感圧導電弹性体を用いる構成であるため、従来のブッシュスイッチの自動組立機を用いて組み立てることができ、大幅な工数削減を可能とすることができる優れた感圧スイッチを実現できるものである。

【図面の簡単な説明】

【図1】(a) 本発明の第1の実施例における感圧スイッチの側面図

(b) 同第1の実施例における感圧導電弹性体の平面図
 (c) 同第1の実施例における下部フィルムの平面図
 (d) 同第1の実施例における感圧スイッチの等価回路

【図2】同第1の実施例における感圧スイッチの動作説明のための斜視図

【図3】本発明の第2の実施例における感圧スイッチの

断面図

【図4】本発明の第3の実施例における感圧スイッチの断面図

【図5】本発明の第1、第2、第3の実施例における感圧スイッチの等価回路出力特性図

【図6】(a) 従来の感圧スイッチの側面図

(b) 同上部フィルムの平面図

(c) 同要部である感圧導電ゴムの底面図

(d) 同下部フィルムの平面図

(e) 同等価回路図

【符号の説明】

19 20, 21, 22, 41a, 42a, 51a, 5

2 a 固定接点

30, 44, 54 感压導電彈性體

33, 44a, 54a 導覽

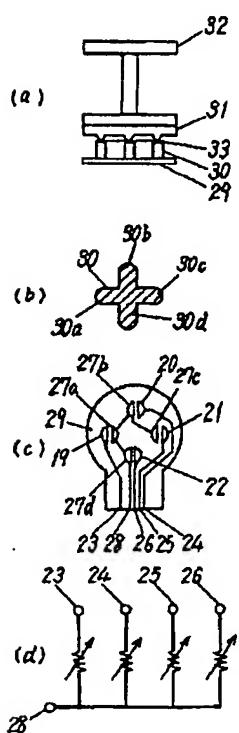
45, 55 ドーム状弹性

45a; 55a 押し鉢

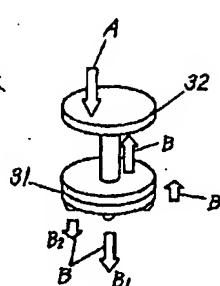
45b, 55b 押庄部

45c, 55c 外。

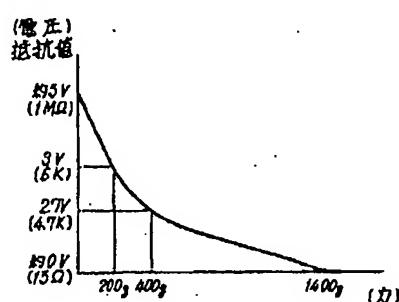
[图1]



[图2]



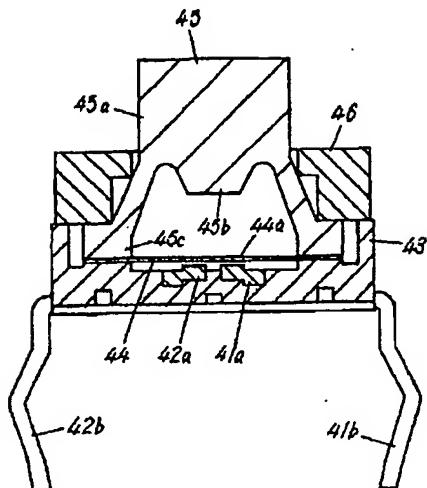
[图5]



【図3】

41a,42a 固定接点
 44 感压導電
 弹性体
 44a 導電膜
 45 ドーム状
 弹性体

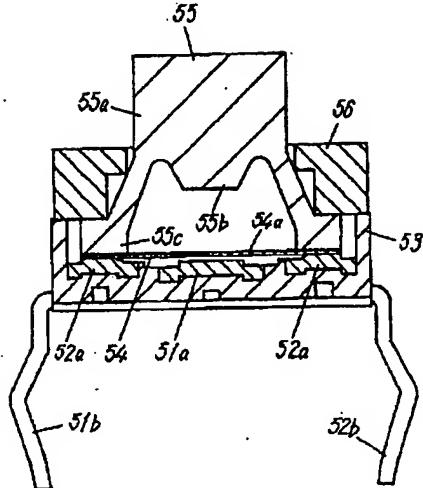
45a 押し鉗部
 45b 壓圧部
 45c 外周支持部
 46 カバー



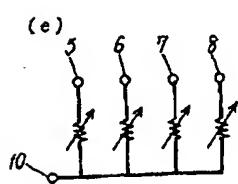
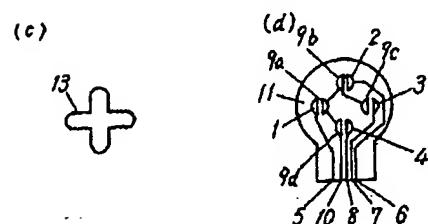
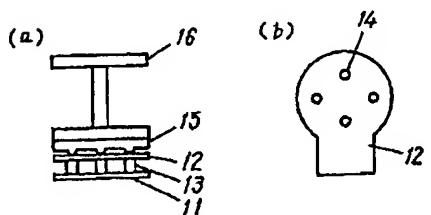
【図4】

51a,52a 固定接点
 54 感压導電
 弹性体
 54a 導電膜
 55 ドーム状
 弹性体

55a 押し鉗部
 55b 壓圧部
 55c 外周支持部
 56 カバー



【図6】



(19) Japan Patent Office (JP) (12) Laid Open Patent Publication (A) (11)Laid Open Patent Application Publication No.
Laid Open Patent Application H08-222070
(43) Publication date August 30, 1996

(51) Int. Cl ⁵	ID	Office Cont. No.	F1	Technical description
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13/52		4235·5G	13/52	Z
25/04			25/04	C
<u>Examination Apply No Number of claims 4 OL (total 5 pages)</u>				
(21) Appl. No. Patent Application H07-28158	(71) Applicant 000005821 Panasonic Electric Industrial Co., Ltd. 1006 Oaza Kadoma, Kadoma-shi, Osaka			
(22) Filing date February 16, 1995	(72) Inventor Tamotsu Yamamoto c/o Panasonic Electric Industrial Co., Ltd. 1006 Oaza Kadoma, Kadoma-shi, Osaka			
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	(74) Representative Akira Okaji, Patent Attorney (and two others)			

(54) [Title of the invention] Pressure-sensitive switch

(57) [Abstract]

[Objective]

To provide pressure force detection with good sensitivity in a pressure-sensitive switch used in the input operation of a sound device, video device, or gaming device or the like.

[Structure]

Common secure connection points 27a, 27b, 27c, and 27d are attached to a lower film 29 facing four independent secure connection points 19·22 arranged in four directions, and a pressure-sensitive electroconductive elastic body 30 having an electroconductive coating 33 on the pressure operating surface side opposite to the side that is in contact with the secure connection points 19·22 is placed on the secure connection points 19·22.

Furthermore, a pressure plate 31 having protrusions for pressing the pressure-sensitive electroconductive elastic body 30 and an operating lever 32 placed on the pressure plate 31 for pressing it in the direction of applied force are provided so that a superior pressure-sensitive switch is obtained capable of changing the resistance value of the pressure-sensitive electroconductive elastic body 30.

[Claims]

[Claim 1]

A pressure-sensitive switch comprising at least two secure contact points and a pressure-sensitive electroconductive elastic body that is placed on said secure contact points and coated with an electroconductive material to form an electroconductive coating on the pressure operating surface side opposite to the side that is in contact with said secure connection points.

[Claim 2]

The pressure-sensitive switch according to Claim 1, wherein a dome-shaped elastic body having a press button at the top center, a pressuring part at the bottom center, and a peripheral supporting part is placed on said pressure-sensitive electroconductive elastic body.

[Claim 3]

The pressure-sensitive switch according to Claim 2, wherein said pressing part of said dome-shaped elastic body is placed on two secure contact points via said pressure-sensitive electroconductive elastic body.

[Claim 4]

The pressure-sensitive switch according to Claim 2, wherein said pressing part of said dome-shaped elastic body is placed on the center secure contact point via said pressure-sensitive electroconductive elastic body, said peripheral supporting part of said dome-shaped elastic body is placed on the peripheral secure contact points via said pressure-sensitive electroconductive elastic body, and said pressure-sensitive electroconductive elastic body is clamped by a cover having an opening through which said press button of said dome-shaped elastic body protrudes via said peripheral supporting part of said dome-shaped elastic body.

[Detailed explanation of the invention]

[0001]

[Scope of the invention]

The present invention relates to a pressure-sensitive switch in which a pressure-sensitive electroconductive elastic body is placed on secure contact points and coated with an electroconductive material to form an electroconductive coating on the pressure operating surface side opposite to the side that is in contact with the secure contact points.

[0002]

[Prior art technology]

In recent years, there has been heightened desire for pressure-sensitive switch used in the input operation of a sound device, video device, or gaming device or the like to have improved pointing device sensitivity.

[0003]

An explanation is provided hereafter concerning conventional pressure-sensitive switches. Figure 6 (a)-(e) shows the structure of conventional pressure-sensitive switches. In the drawing, 1-4 indicate four independent secure contact points arranged in four directions; 5-8 represent leads drawn from the secure contact points; 9a, 9b, 9c, and 9d represent common secure contact points respectively facing the four independent contact points 1-4, no. 10 represents a lead drawn from the common secure contact points, and which are attached to a lower film 11. No. 12 represents an upper film, to which movable contact points 14 are attached. No. 13 is a pressure-sensitive electroconductive rubber having variable resistance in accordance with the pressure between the secure and movable contact points in the thickness direction. No. 15 is a pressure plate having protrusions in four directions for pressing the points in four directions on the pressure-sensitive electroconductive rubber 13, and no.16 represents an operating lever that is arranged on the pressure plate and pushes it in the direction of applied force.

[0004]

Changes in resistance between individual contact points are measured by measuring respective resistances between the lead line 10 and the lead lines 5·8. In other words, measurements of resistances between the top and bottom at each position of the pressure-sensitive rubber provide information on in which direction and of what magnitude the force is applied, namely the "direction" and "magnitude" of the force.

[0005]

[Problems overcome by the invention]

However, the above structure requires the upper film 12 having the movable contact points 14 on the pressure-sensitive electroconductive rubber 13. Therefore, when the switch is operated, the protrusions of the pressure plate 15 push the pressure-sensitive electroconductive rubber 13 via the upper film 12. This raises a problem that the pressure-sensitive electroconductive rubber 13 is less sensitive under influence of the thickness and rigidity of the upper film 12.

[0006]

The present invention resolves the prior art problem described above and the purpose of the present invention is to provide a pressure-sensitive switch having an excellent pressure detection sensitivity.

[0007]

[Problem resolution means]

In order to achieve the above purpose, the pressure-sensitive switch of the present invention comprises one or at least two secure contact points and a pressure-sensitive electroconductive elastic body that is placed on the secure contact points and coated with an electroconductive material to form an electroconductive coating on the pressure operating surface side opposite to the side that is in contact with the secure connection points.

[0008]

[Efficacy]

With the above structure comprising four pairs of independent secure contact points arranged in four directions, a film on which leads drawn from these secure contact points are wired, a pressure-sensitive electroconductive elastic body that is placed on the secure contact points and coated with an electroconductive material on the pressure operating surface side opposite to the side that is in contact with the secure contact points, a pressure plate having protrusions in four directions for pressing the pressure-sensitive electroconductive elastic body on the secure contact points, and an operating lever that is placed on the pressure plate 31 for pressing the pressure plate in the direction of applied force, the force applied to the operating lever is further applied to the pressure-sensitive electroconductive elastic body in the four directions through the protrusions of the pressure plate so that changes in the resistance of the pressure-sensitive electroconductive elastic body can be read from the leads.

[0009]

[Embodiments]

(Embodiment 1)

Embodiment 1 of the present invention is described hereafter with reference to the drawings.

[0010]

In Figure 1 (a)-(d), 19-22 indicate four independent secure contact points arranged in four directions; 23-26 represent leads drawn from the secure contact points 19-22; 27a, 27b, 27c, and 27d represent common secure contact points respectively facing the four independent secure contact points 19-22; no. 28 represents a lead drawn from the common secure contact points, and which are attached to a lower film 29. Above the four independent secure contact points 19-22 provided are the tips 31a, 30b, 30c, and 30d of a pressure-sensitive electroconductive elastic body 30 made of a pressure-sensitive electroconductive rubber that is coated with an electroconductive material to form an electroconductive

coating 33 on the pressure operating side opposite to the side that is in contact with the secure contact points 19-22.

[0011]

Furthermore, a pressure plate 31 having protrusions in four directions for pressing the pressure-sensitive electroconductive elastic body 30 on the secure contact points 19-22 and an operating lever 32 placed on the pressure plate 31 for pressing the pressure plate 31 in the direction of applied force are provided. As shown in the equivalent circuit, measurements of resistances between the lead 28 and the leads 23-26 provide changes in resistance between the individual contact points.

[0012]

The operation of the pressure-sensitive switch having the above structure is described hereafter with reference to Figure 2.

[0013]

When the operating lever 32 is pressed by a force in the arrowed direction A, forces B are applied to four protrusions of the pressure plate in accordance with the pressed position and in the arrowed direction B. Particularly, the pressure-sensitive electroconductive elastic body 30 receives the downward forces B_1 and B_2 . Therefore, measurements of the resistance between the top and bottom of the tips 30a, 30b, 30c, and 30d of the pressure-sensitive electroconductive elastic body provide information on in which direction and of what magnitude the forces is applied, namely the "direction" and "magnitude" of the force. The resistance is decreased as shown in the equivalent circuit output property of Fig.5. Measurements of the resistance of the pressure-sensitive electroconductive elastic body 30 provide the pressure; for example, the pressure is 200 g when the pressure-sensitive electroconductive elastic body 30 has a resistance of 6 K Ω through the thickness.

[0014]

As described above, in this embodiment, a thin electroconductive coating 33 is formed on the top surface of the pressure-sensitive electroconductive elastic body 30, for example, by printing. The prior art upper film is eliminated and the pressure-sensitive

electroconductive elastic body 30 is directly pressed, improving the pointing device sensitivity.

[0015]

(Embodiment 2)

Embodiment 2 of the present invention is described hereafter with reference to the drawings.

[0016]

In Figure 3, 41a and 42a represent a pair of facing secure contact points that are insert molded in a switch case 43 and conductive to output terminals 41b and 42b, respectively. Above the secure contact points 41a and 42a provided is a pressure-sensitive electroconductive elastic body 44 coated with an electroconductive material to form an electroconductive coating 44a on the pressure operating side opposite to the side that is in contact with the secure contact points 41a and 42a. Above it, a dome-shaped elastic body 45 having a push button part 45a, a pressing part 45b, and a peripheral supporting part 45c is provided. The dome-shaped elastic body 45 is held and covered with a cover 46.

[0017]

The operation of the pressure-sensitive switch having the above structure is described hereafter with reference to Figure 3.

[0018]

When the push button part 45a of the dome-shaped elastic body 45 is pressed down, the pressing part 45b makes contact with the pressure-sensitive electroconductive elastic body 44 around the center. Upon further pressing, the pressure-sensitive electroconductive elastic body 44 is clamped and pressed by the secure contact points 41a and 42a and the push button part 45a through the thickness. Consequently, the resistance through the thickness of the pressure-sensitive electroconductive elastic body 44 is gradually decreased in accordance with the pressure as shown in the equivalent circuit output property of

Figure 6 and, finally, the output terminals 41a and 42b become conductive. Then, an electric current path 42b·42a·44·44a·44·41a·41b is established.

[0019]

As described above, in this embodiment, the output resistance is changed in accordance with the pressure applied by pressing the push button part 45a while the prior art push-switch is provided with metal contact points capable of detecting only the state ON/OFF in place of the pressure-sensitive electroconductive elastic body 44. Then, the present invention can be used as a multistage switch when connected to a voltage comparator or an A/D converter.

[0020]

(Embodiment 3)

Embodiment 3 of the present invention is described hereafter with reference to the drawings.

[0021]

In Figure 4, 51a and 52a represent a pair of secure contact points that are insert molded in a switch case 53 and conductive to output terminals 51b and 52b, respectively. Above the secure contact points 51a and 52a provided is a pressure-sensitive electroconductive elastic body 54 coated with an electroconductive material to form an electroconductive coating 54a on the pressure operating side opposite to the side in contact with the secure contact points 51a and 52a. Above it, a dome-shaped elastic body 55 having a push button part 55a, a pressing part 55b, and a peripheral supporting part 55c is provided. The dome-shaped elastic body 55 is clamped by a cover 56. Therefore, the peripheral supporting part 55c receives a large load and has a small resistance through the thickness, then making it conductive through the thickness.

[0022]

The operation of the pressure-sensitive switch having the above structure is described hereafter with reference to Figure 4. When the push button part 55a of the dome-shaped

elastic body 55 is pressed down, the pressing part 55b makes contact with the pressure-sensitive electroconductive elastic body 54 around the center. Upon further pressing, the pressure-sensitive electroconductive elastic body 54 is clamped and pressed by the secure contact points 51a and the pressing part 55b through the thickness. Consequently, the resistance through the thickness of the pressure-sensitive electroconductive elastic body 54 is gradually decreased in accordance with the applied pressure as shown in the equivalent circuit output property of Figure 6 and, finally, the output terminals 51b and 52b become conductive. Then, an electric current path 51b-51a-54-54a-54-52a-52b is established.

[0023]

As described above, in this embodiment, the pressure-sensitive electroconductive elastic body 54 above the secure contact points 52a is clamped by the cover 56 via the peripheral supporting part 55c of the dome-shaped elastic body 55 and the resistance of the pressure-sensitive electroconductive elastic body 54 at this part is substantially decreased. Therefore, the change in resistance of the pressure-sensitive electroconductive elastic body 54 only at one area above the secure contact points 51a is supplied between the output terminals 51b and 52b. This allows more stable detection of the applied pressure. Then, the present invention can be used as a multistage switch when connected to a voltage comparator or an A/D converter.

[0024]

The pressure-sensitive electroconductive elastic body can be a rubber, resin, or insulating film that is coated with a pressure-sensitive electroconductive material to form an electroconductive coating thereon.

[0025]

[Efficacy of the invention]

As described above, the present invention uses a pressure-sensitive electroconductive elastic body that is coated with an electroconductive material to form an electroconductive coating on the pressure operating side opposite to the side that is in contact with the secure contact points. Therefore, because a pressure is directly applied to the pressure-

sensitive electroconductive elastic body by the pressing part, higher pressure detection sensitivity can be obtained compared to the prior art structure using an upper film.

[0026]

Furthermore, a push switch using as a movable contact point the pressure-sensitive electroconductive elastic body that is coated with an electroconductive material to form an electroconductive coating thereon can serve as a multistage switch, which is not available from the prior art structure. In addition, with the pressure-sensitive electroconductive elastic body being used in place of movable contact points of the prior art push switch, an excellent pressure-sensitive switch that can be assembled in an automated prior art push switch assembly machine and allows a significantly reduced number of production steps can be realized.

[Brief explanation of the drawings]

[Figure 1]

- (a) A side view of the pressure-sensitive switch according to Embodiment 1 of the present invention.
- (b) A plane view of the pressure-sensitive electroconductive elastic body of Embodiment 1.
- (c) A plane view of the lower film of Embodiment 1.
- (d) An illustration showing an equivalent circuit of the pressure-sensitive switch of Embodiment 1.

[Figure 2]

A perspective view to explain the operation of the pressure-sensitive switch of Embodiment 1.

[Figure 3]

A cross-sectional view of the pressure-sensitive switch of Embodiment 2 of the present invention.

[Figure 4]

A cross-sectional view of the pressure-sensitive switch of Embodiment 3 of the present invention.

[Figure 5]

A graphical representation showing the equivalent circuit output property of the pressure-sensitive switches of Embodiments 1, 2, and 3 of the present invention.

[Figure 6]

- (a) A side view of a prior art pressure-sensitive switch.
- (b) A plane view of the upper film of the same.

- (c) A bottom view of the pressure-sensitive electroconductive rubber, which is a core part, of the same.
- (d) A plane view of the lower film of the same.
- (e) An illustration showing an equivalent circuit of the same.

[Legend]

19, 20, 21, 22, 41a, 42a, 51a, 52a	secure contact point
30, 44, 54	pressure-sensitive electroconductive elastic body
33, 44a, 54a	electroconductive coating
45, 55	dome-shaped elastic body
45a, 55a	push button
45b, 55b	pressing part
45c, 55c	peripheral supporting part
46, 56	cover

[Figure 1]

19, 20, 21, 22	secure contact point
30	pressure-sensitive electroconductive elastic body
33	electroconductive coating

[Figure 2]

[Figure 3]

41a, 42a	secure contact point
44	pressure-sensitive electroconductive elastic body
44a	electroconductive coating
45	dome-shaped elastic body
45a	push button
45b	pressing part
45c	peripheral supporting part
46	cover

[Figure 4]

51a, 52a	secure contact point
54	pressure-sensitive electroconductive elastic body

54a	electroconductive coating
55	dome-shaped elastic body
55a	push button
55b	pressing part
55c	peripheral supporting part
56	cover

[Figure 5]

ordinate: (voltage) resistance / approx. 5 V ($1 \text{ M}\Omega$) / 3 V (6 K) / 2.7 V (4.7 K) / approx. 0 V
(15Ω);
abscissa: (force)

[Figure 6]

CERTIFICATE OF TRANSLATION

I Roger P. Lewis, whose address is 42 Bird Street North, Martinsburg WV 25401, declare and state the following:

I am well acquainted with the English and Japanese languages and have in the past translated numerous English/Japanese documents of legal and/or technical content.

I hereby certify that the Japanese translation of the attached translation of documents identified as:

Laid Open Patent Application H08-222070
"Pressure-sensitive switch"

is to the best of my knowledge and ability true and accurate.

I further declare that all statements contained herein of our own knowledge, are true, that all statements of information and belief are believed to be true.



ROGER P. LEWIS

September 26, 2006